#9(NE)
8/27/02

(19) Japanese Patent Office (JP)

(12) Kokai Unexamined Patent Application Bulletin (A)

(11)	Laid Open Patent Application No.	57-105974
(43)	Publication Date	July 1, 1982
	Number of Inventions	1
	Number of Pages	5
	Examination Request	not yet made

(51) Int. Cl.^{3}	Identification Code	Internal File No.
H 01 M 8/02		7268-5H
8/24		7268-5H

(54) Fuel Cell

(21) Application No.: 55-182141

(22) Application Date: December 24, 1980

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SPECIFICATION

1. TITLE OF THE INVENTION: Fuel Cell

2. CLAIMS

(1) In a fuel cell provided with an interconnector which forms a fluid oxidizer channel and a fluid fuel channel, so as to contact a pair of electrodes containing an electrolyte, and wherein energy is output under conditions where fuel and oxidizer flow through the channels, a fuel cell characterized in that metal is used for the substrate of said interconnector, and in that the surface of this substrate is coated with a mixed coating of a heat resistant and chemically resistant binder and graphite.

(2) The fuel cell of claim 1, characterized in that the substrate surface is coated with a mixed coating of a Teflon based adhesive and graphite.

(3) The fuel cell of claim 1, characterized in that a suspension, in which a Teflon based adhesive and graphite particles are dispersed, is sprayed or painted onto the substrate surface and baked on by way of heat treatment.

(4) The fuel cell of claim 1, characterized in that an electroconductive film comprising a mixture of a Teflon based adhesive and graphite is pressure sealed onto the substrate surface.

(5) The fuel cell of claim 1, characterized in that phosphoric acid is used as the electrolyte.

3. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to fuel cells, in particular, it relates to an improved interconnector which comprises grooves for the purpose of fluid fuel channels and fluid oxidizer channels, and performs a current collector function.

Conventionally, fuel cells are known as devices that directly convert the energy in fuels into electrical energy. These fuel cells are such that, a pair of porous electrodes is positioned so that electrolyte is present therebetween; furthermore, a fluid fuel such as hydrogen is contacted with the back of one electrode, while a fluid oxidizer such as oxygen is contacted with the back of the other electrode; and the electrochemical reaction that occurs at this time is exploited so as to take electrical energy from between the electrodes; so long as the fuel and the oxidant are supplied, it is possible to take electrical energy at a high conversion efficiency.

Based on principles such as described above, the unit cells of a fuel cell are normally constituted in the manner shown in FIG. 1 (a), [*sic*] and an entire fuel cell device is constituted in the manner shown in FIG. 2, by stacking a plurality of these unit cells. In other words, in FIG. 1, the unit cell is such that electrodes 2 and 3, which are formed of a porous material to which a catalyst has been added, are positioned on either side of a matrix 1, which has been impregnated with an electrolyte; furthermore, plates 6 (hereinafter referred to as interconnectors) are positioned with ribs 4 and 5,

respectively, on the backs opposite the matrix 1 side. The faces of the interconnectors 6 on sides of the electrodes 2 and 3, are provided, by way of the ribs 4 and 5, with a plurality of regularly spaced groves 7 and 8, which are oriented so as to cross each other; these groves 7 and 8 constitute the channels for the fluid fuel and the fluid oxidizer, respectively. In like manner, groves 7 and 8, which are oriented so as to cross each other, are also formed on the opposite sides of interconnectors 6, by way of ribs 4 and 5, and serve as channels for the fluid fuel and the fluid oxidizer for the adjacent unit cells. The matrixes 1, the electrodes 2 and 3, and the interconnectors 6 are stacked in this manner; and in this state, a unit cell is constituted by sealing each of the edges of the stack in an airtight manner, so that only the openings at the ends of grooves 7 and 8 of the interconnectors 6 remain.

A plurality of unit cells constituted in the manner of FIG. 1 are stacked so that, as shown in FIG. 2, a stack is such that a manifold 10, having a fuel supply opening 9, is provided at one of a [pair of] opposing faces, and a manifold 12, having a fuel discharge opening 11, is provided at the other; furthermore, a manifold 14, having an oxidizer supply opening 13, is provided at one of another [pair of] opposing faces, and a manifold 16, having an oxidizer discharge opening 15, is provided at the other; and these manifolds 10, 12, 14 and 16 are maintained airtight by rigidly fixing them with bolts, etc.; and a fuel cell device 17 is thereby constituted. Thus, according

to this fuel cell device 17, if a fluid fuel is supplied via fuel supply opening 9, this fuel is distributed along the plurality of grooves 7 which comprise the channels of each unit cell, and flows in contact with the back of the electrode 2; thereafter, it is discharged via fuel discharge opening 11. If a fluid oxidizer is supplied via oxidizer supply opening 13, this oxidizer is distributed along the plurality of grooves 8 which comprise the channels of each unit cell, and flows in contact with the back of the electrode 3; thereafter, it is discharged via oxidizer discharge opening 15; [thus] both the fluid fuel and the fluid oxidizer are dispersed, and thereby provided to the interior electrodes 2 and 3, and electrical energy is generated by the fuel cell. In the figures, the output terminal has been omitted.

However, in conventional fuel cells constituted as described above, molded parts [made] of materials comprising a phenol-based binder and particulate graphite are used as interconnectors. Such conventional interconnectors have had the following problems.

(1) It is very industrially difficult to manufacture large, thin sheets for interconnectors.

(2) After molding the sheets, the grooves are machined, which results in a loss of material, which increases material costs.

(3) If the interconnectors are too thick, the electrical resistance thereof increases, and the voltage drop increases, resulting in a great loss in the electrical energy output.

(4) As the interconnectors are thick, the battery is heavy (the weight

of the interconnectors comprises 95% or more of a unit cell's weight).

(5) As phenol-based binders are used, the service life is short.

As the present invention is a reflection of such circumstances, an object thereof is to provide a fuel cell having interconnectors which are easy to manufacture, which eliminate material waste, which have great electrical conductivity, which are light, and which have a relatively long service life.

The present invention is characterized in that metal is used for the substrate of the grooved interconnector, and in that the surface of this metal interconnector substrate is coated with a mixed coating of a heat resistant and chemically resistant binder and particulate graphite.

In the following, one embodiment of the present invention will be described in further detail with reference to the drawings.

FIG. 3 is an external view of a fuel cell interconnector according to the invention; in the drawing, diagonally shaded sections [show] a cross section of the interconnector. [Reference numeral] 18 [indicates] a metal interconnector substrate which constitutes the ribbed interconnector substrate. The surface of the metal interconnector substrate 18 is coated with a mixed coating of a heat

resistant and chemically resistant binder and particulate graphite in the form of a paste. On either side of the metal interconnector substrate18,ribs20and21,respectively,areprovided,andconstitute the channels for the fluid fuel and the fluid oxidizer, respectively. Grooves 22 and 23 are formed. The metal interconnector substrate 18 can usually be made into a thin sheet by casting, or by forging; furthermore, machining of grooves 22 and 23 can be achieved easily, as metal cuts well.

A mixed coating 19 which coats the surface of the ribbed metal interconnector 18, formed as described above, is spread on thinly as a paste mixture of a heat resistant and chemically resistant thermosetting or thermoplastic binder and particulate graphite, or a dispersed solution of the mixture is sprayed on to form a thin film; and thereafter this is heat treated to form a thermally and chemically stable coating.

It is not necessary that the ribbed metal interconnector substrate 18 be manufactured by machining a sheet: the excellent molding characteristics of metals make it possible to manufacture a ribbed interconnector substrate directly.

Other variants of the ribbed metal interconnector 18 are described by way of FIG. 4 and FIG. 5. FIG. 4 (a) shows a sectional view, sectioned perpendicularly to the planar direction of a thin sheet, preferably

no thicker than 1.5 mm, bent to form a ribbed metal interconnector substrate 24. FIG. 4(b) is a plane view of FIG. 4(a) seen from the bottom. In FIGS. 4(a) and (b), 24 [indicates] a ribbed metal interconnector substrate formed by bending a thin sheet into a rectangular waveform; and 25 [indicates] grooves in the form of spaces resulting therefrom. [Reference numeral] 26 [indicates] a partition which prevents fluids from flowing into this space. {Reference numeral] 27 [indicates] a heat resistant and chemically resistant electroconductive coating. FIG. 5 [represents] a two-sided, grooved interconnector having a constitution wherein two of the ribbed interconnector substrates 24 [are positioned] so that the grooves 28 of the ribbed interconnector substrates 24 cross, and the sides of the metal surface on which the coating 27 has been provided [*sic*] are brought together.

In FIG. 4 and FIG. 5, the grooves have a rectangular shape, but the grooves may be in other waveforms which form grooves, and are not limited to rectangular shapes.

Preferably, phenol resins, Teflon, etc. are used as the heat resistant and chemically resistant binder.

Next, the effects of the invention will be described by way of practical embodiments thereof.

Embodiment 1: After suspending graphite particles in a fluorine resin dispersion, and spraying this onto the surface of a grooved steel interconnector with a sprayer, this was heat treated; the thickness of the coating formed was 0.1 mm, and the electrical resistance thereof was 0.01 Ω. No change whatsoever was observed at two weeks or more in 95% phosphoric acid, at a temperature of 190°C, nor was corrosion of the steel interconnector substrate observed.

Embodiment 2: A grooved interconnector, wherein a sheet of 0.5 mm in thickness was formed with a roller, from a mixed paste wherein graphite particles were dispersed in a fluorine resin suspension, and press molded and hot sealed onto the surface of a grooved stellite interconnector substrate, was immersed in 95% phosphoric acid, at 190°C, for two weeks, and the result thereof was that no change whatsoever was observed.

As described above, by virtue of the present invention, mass production by means of inexpensive and simple manufacturing is made possible; great reduction in the weight of fuel cells made possible; heat loss as a result of ohmic drop is reduced; and it is possible to provide a fuel cell of which an increased service life can be expected.

4. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view showing a unit cell of a conventional fuel cell; FIG. 2 is a perspective view of a conventional

fuel cell incorporating these [unit] cells; FIG. 3 is a perspective view showing an interconnector which is a constituent element of a fuel cell according to one embodiment of the present invention; and FIG. 4 and FIG. 5 are explanatory diagrams showing a variant of the present invention.

1... matrix; 2,3... electrodes

4,5... ribs; 6, 29... interconnectors

18... interconnector substrate

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FIG. 1

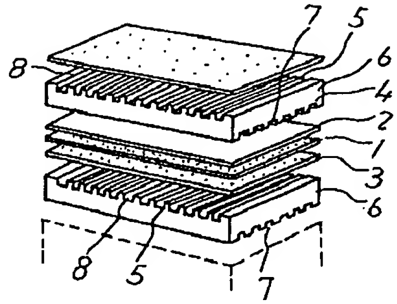

FIG. 3

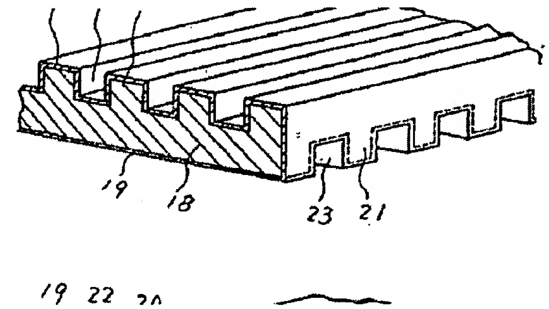

FIG. 2

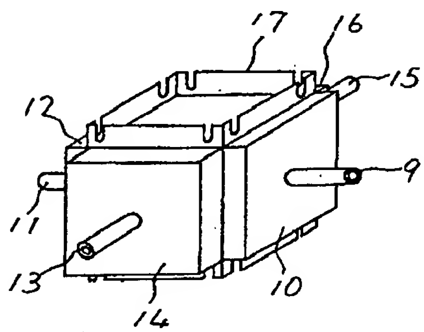

FIG. 4

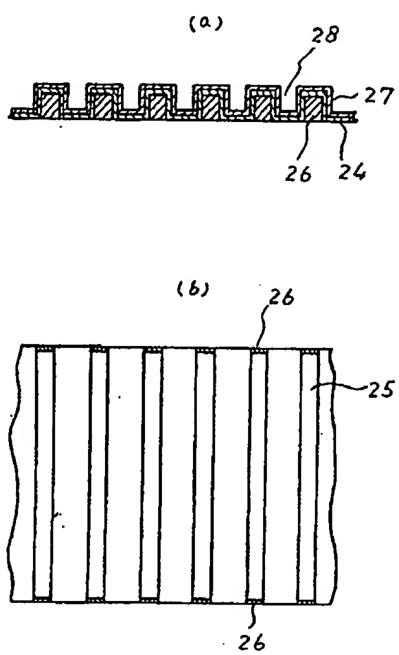

FIG. 5